Web-Based Learning through Objective Questions

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About the Authors

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Abstract

The potential of the World Wide Web as a medium to enhance students’ learning is indeed promising and a relevant research undertaking in engineering education. Since most universities worldwide have their own home pages in the internet accessible to both faculty and students via user-friendly Web browsers, then education and learning resources must be developed and published in the Web to maximize the usefulness of this new technology in higher education. In line with this thrust, a Web-based Learning Module in a basic civil engineering course in structural analysis was developed and tested at the home page of De La Salle University. This paper briefly describes this learning module and summarizes the evaluation and feedback of undergraduate students in civil engineering on the use of the module.
INTRODUCTION

The development of fast and affordable microcomputers and the tremendous popularity and availability of the Internet or World Wide Web (WWW) have started to transform the processes of teaching and learning in higher education. Educators and students in universities in engineering have started to understand and explore the potential of this Web technology in the delivery of educational and learning materials. With this in mind, the first author advised and guided a group of undergraduate students in developing a Web-based Learning Module (WLM) in a basic civil engineering course in structural analysis [1]. Specifically, the project aims (a) to supplement the traditional classroom learning materials, (b) to serve as a review material in preparation for an examination, and (c) to open the possibility of adapting an on-line system in providing Continuing Professional Education (CPE) for professional engineers. The WLM in Structural Analysis was completed in 1999 and was published in the home page of the Department of Civil Engineering, De La Salle University-Manila.

This paper is an extended version of the paper published in the Journal of Computer Applications in Engineering Education [2]. The objective of this paper is to show the process, principles and tools used in developing a Web-based Learning Module. In the succeeding sections, the objectives and features of the WLM in Structural Analysis are described. Then a summary of the evaluation and feedback of undergraduate students is also presented. Hopefully, this paper will serve as a guide and model to future WLM developers.

WEB SITE AND HOME PAGE

The WLM in Structural Analysis may be accessed directly by the Web address http://www.dlsu.edu.ph/colleges/coe/civil/frontpage or indirectly by first locating the home page of De La Salle University (DLSU) System with the Web address http://www.system.dlsu.edu.ph. Within the DLSU System home page, choose the options in the following order: DLSU-Manila, Colleges, College of Engineering, Civil Engineering and Learning Module in Structural Analysis. The parent page or home page of the Web-based Learning Module in Structural Analysis is shown in Figure 1.

![Image of homepage of the WLM in Structural Analysis](image-url)

Figure 1. Homepage of the WLM in Structural Analysis
The WLM home page provides access to the following materials:
(a) information about the authors,
(b) an introduction describing the WLM’s intended audience, features, contents, topics and objectives, and
(c) the four Web-based Learning Modules classified as
  • Module 1: Stability and Determinacy of Structures
  • Module 2: Analysis of Statically Determinate Trusses
  • Module 3: Elastic Structural Analysis
  • Module 4: Stress Analysis
The user has the choice which module he/she wants to take.

COMPONENTS OF A LEARNING MODULE

The Web page of each learning module contains an introduction describing the general scope of the module and some definition of terms, the degree of difficulty of the questions, and the topics covered. It also enumerates the specific objectives of the Multiple-Choice Questions (MCQs) to make clear to the user what is being tested in the module. If a user wants to start and read the objective questions, the “Question No. 1” hover button can be activated when the mouse pointer is moved over the button and clicked. The web page of an MCQ is then displayed for the learner to analyze and answer. A typical MCQ web page is shown in Figure 2.

Figure 2. Typical MCQ Web Page

The MCQ Web page in Figure 2 consists of the problem statement or question, sometimes accompanied with a figure and the choices for the answer which may be in the form of figures or text. To answer the specific question, the user simply clicks on a specific choice. Each MCQ Web page is linked to four Web pages corresponding to the four choices in the objective questions. If the choice is incorrect, a Web page is displayed showing a message “Wrong” and some hints and information on why the choice is incorrect (Figure 3). This feedback is intended to guide the user or learner on how to get the correct
Figure 3. A "Wrong" Choice Web Page

Figure 4. A "Right" Choice Web Page
answer. A suggestion of references for further reading is also included. The user returns to the question and makes another choice. If the choice is correct, a “Right” message and a brief information about the answer are displayed (Figure 4). The user may then proceed to the next question. The user has to option to move to the next module or stop after completing a module.

LEARNING THROUGH OBJECTIVE QUESTIONS OR MCQs

The WLM in Structural Analysis was designed for students who already have a background in Strength of Materials and Structural Analysis. It was designed for users or learners who would like to test their understanding and comprehension on the basic concepts and principles of structural analysis. It was not designed to deliver a course through the Web like a hypercourse; thus you would not expect lecture materials in these modules. The WLM in Structural Analysis aims to deepen the understanding of a learner on the basic concepts and principles through objective questions. Teaching through objective questions helps the student in learning and developing [3]. Objective questioning helps the learner to sharpen one’s ideas through a process of reflection on the material and interaction with it. Therefore, in these modules, the learning materials are presented in the form of a Multiple Choice Questions (MCQs) or objective questions whereby a student or learner is posed a problem and has to choose the best answer from four options. With this approach, the learner needs to reflect on the problem, apply basic concepts and principles, use formulas and equations, and then choose the correct and best answer. A feedback is given whenever the choice is incorrect to guide the learner on how to arrive at the correct answer. This process of instant feedback is intended to make the learning module interactive and not static. From the given hints and information, the learner is guided on how to solve the problem. Only when the learner gets the correct answer that he/she moves to the next question. By going through these series of MCQs or objective questions, the user will have a better and deeper understanding of the subject matter.

The Multiple Choice Questions (MCQs) or objective questions were designed to test the student’s knowledge and understanding of important terms, concepts, principles and assumptions related to a specific topic. The student is also tested on his/her ability to apply these concepts and principles by subjecting him or her to problems which require numerical calculation.

MCQs can be presented using plain text only or accompanied by figures or diagrams. Presenting the MCQs as pure text is the most difficult for the learner because he/she has to use his/her imagination to formulate the problem since the question is not provided with figures. However, the learner is tested on his familiarity with standard definitions, terms and symbolic notations. When the MCQs are accompanied by figures or diagrams, the learner is evaluated on his/her ability to interpret the given figures or diagrams and relate them to the basic concepts.

Using figures or pure text in presenting MCQs has advantages and disadvantages. From the point of view of the learner, the problem may be easily understood when accompanied with figures; however, drawing figures requires extra effort and skill for the Web site developer and adequate computer memory is required. On the other hand, MCQs in pure text are more difficult to formulate since the questions have to be properly designed, complete with descriptions and definitions, and at the same time, they must be short and concise. MCQs in pure text, however, are easier to create and publish in the Web. The WLM developer may use a combination of these formats depending on the topic and specific learning objectives of a module.

DESIGN OF WEB PAGES

There are various ways of preparing and publishing Web documents. You can write the documents or Web pages from scratch in HTML (Hyper Text Markup Language) using a tool like Java or JavaScript. This approach of developing Web pages may be time consuming and complicated especially if the developer is not familiar with HTML. A more convenient and faster way is to use a software where
documents can be written easily using a familiar and user-friendly editor and can be converted into a file with HTML format so that it can be published in the Web. This can be done using the latest version of Microsoft Word or Microsoft FrontPage. With this approach, a faculty or student without a knowledge of HTML can easily publish Web pages in the university home page.

The design of the Web pages of the WLM in Structural Analysis was created using Microsoft FrontPage [4]. MS FrontPage, a Web creation and management tool, does not require programming knowledge and is robust enough for experienced Web site developers. It consists of two useful tools, the FrontPage Editor and the FrontPage Explorer. The FrontPage Editor is a tool for creating, designing, and editing Web pages. Texts, images, tables, form fields and other elements can be added to your page and FrontPage Editor displays them as they would appear in a Web browser. There is no need to learn HTML because FrontPage Editor creates all HTML code and generates all popular HTML tags, including extensions such as cascading style sheets. When the FrontPage document is completed, the FrontPage Explorer is used to publish it on the computer, the university intranet or the World Wide Web.

The design of the WLM is of course subject to the limitations of a software like MS FrontPage. For example, the developers intended to display as feedback the rating of the performance of a user on the MCQs after completing a module. But with MS FrontPage only, this is not possible. This would require some programming using a different software and integrating the program into the Web page.

EVALUATION AND FEEDBACK

To evaluate the effectiveness of the WLM in enhancing students’ learning and understanding, the WLM in Structural Analysis was tested by the author’s class in STRUCT2 (Structural Analysis II) during the First Term of SY 2000-2001. Before the final examination, the students were encouraged to test the WLM and give their evaluation. Students who tested the WLM were required to evaluate the WLM on ten items listed in Table 1.

Table 1. Items Evaluated by the Students

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The WLM is effective as a reviewer for a test.</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>2</td>
<td>The WLM encourages self-study.</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>3</td>
<td>The WLM is user friendly.</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>4</td>
<td>The WLM enhances preparation in the final exam.</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>5</td>
<td>I spent too much time answering the questions.</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>6</td>
<td>Some questions are difficult to understand.</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>7</td>
<td>Some questions are confusing.</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>8</td>
<td>I learned new concepts from the WLM.</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>9</td>
<td>My understanding of concepts was improved.</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>10</td>
<td>I will use WLM if available in other subjects.</td>
<td>(1) (2) (3) (4) (5)</td>
</tr>
</tbody>
</table>

Scale: (1) Strongly Agree (2) Agree (3) No Opinion (4) Disagree (5) Strongly Disagree

Forty-four students tried the WLM before taking the final examination. Figure 5 shows the average rating of the students on the ten items.
The evaluation of the students in the WLM may be summarized as follows:

1. Is the WLM useful as a reviewer for a test, particularly for the final exam? Items no. 1 and 4 address this issue and the evaluation was 1.82 and 1.89, respectively.
2. Did it improve your understanding of concepts or have you learned new concepts? The rating of items no. 8 and 9, of 1.80 and 1.86, respectively, indicates an agreement by most students.
3. Are the MCQs properly formulated and easy to understand? The evaluation of items no. 5, 6 and 7, of 2.75, 2.82 and 2.66, respectively, shows that there is a need to improve the formulation and presentation of the questions.
4. A rating of 2.25 for item no. 2 shows that the WLM may be effective in encouraging self study.
5. If available, students will use web-based learning modules or reviewers as shown by the rating of 1.66 for Item no. 10. This high rating should motivate the faculty to develop web-based learning materials in specialized subjects in civil engineering.

Suggestions and comments from the student users were also solicited to further improve the module. In general, the students found the WLM interesting and their constructive comments show their interest in the use of WWW in their learning. These are some of their comments and suggestions:

1. It would be more helpful if you provide clues or hints.
2. Provide better figures and graphics for easy visualization.
3. Provide explanation on why the chosen answer is incorrect.
4. Add sounds and animation to make it more interesting.
5. A scoring scheme should be devised to assess the mastery of the subject.

The WLM can be improved and upgraded by using more sophisticated and flexible software. This would require some programming using a different software like Java. Advanced features such as animation and sounds, as suggested by the students, will be difficult to incorporate in the present WLM. There is indeed a need to improve the WLM for it to be effective as a learning tool.
CONCLUSION

Interactive learning on the Web may be a way to partially supplement the classroom learning experience by providing an interactive environment similar to the classroom but with more attention to individual student needs. The interaction developed in using the Web makes the student engage in the learning process and the individual becomes self-motivated in the discovery of new knowledge. Furthermore, a student can learn at his/her own time, pace and location (home, office, library or laboratory) unlike in a traditional classroom environment.

The project of developing a WLM in structural analysis introduced both the faculty and the students on the potential of the internet as a medium in enhancing teaching and learning. The evaluation and constructive feedback of the students on the use of the WLM is very encouraging. This project should encourage more engineering educators to develop other web-based learning resources such as hypercourses, internet-based exams, virtual laboratory or simple web sites where assignments and homework and even discussions may be posted. It must be realized that the WWW will continuously affect our daily lives including our education. What we, educators, must do is to take advantage of the WWW and to maximize the usefulness of this technology in higher education.

REFERENCES


